

What is claimed is:

1. A system of selecting a brush for use in brushing a catheter lumen, the system comprising:
  - providing a plurality of brushes of varying brush head diameters, the bristles of each respective brush head being of substantially the same length along the brush head's length;
  - identifying a catheter lumen to be brushed and determining its widest cross-sectional internal dimension from along its length;
  - selecting a brush from said plurality of brushes; wherein the ratio of the head diameter of the selected brush to the widest cross-sectional internal dimension of the catheter lumen is greater than 1.0.
2. A system according to claim 1, wherein the ratio of the head diameter of the selected brush to the widest cross-sectional internal dimension of the catheter lumen is greater than 1.2.
3. A system according to claim 2, wherein the ratio of the head diameter of the selected brush to the widest cross-sectional internal dimension of the catheter lumen is within the range 1.25 to 2.5.
4. A system according to claim 1, wherein there is a non-linear relationship between the rate of increase of the widest cross-sectional internal dimension of the catheter lumen and the head diameter of the brush.
5. A system according to claim 4, wherein the rate of increase of brush head diameter is greater than that of the widest cross-sectional internal dimension of the catheter lumen.

6. A system according to claim 1, wherein for catheter lumina with a widest cross-sectional internal dimension of between 0.6 to 2.0 mm, the ratio of the head diameter of the selected brush to the widest cross-sectional internal dimension of the catheter lumen is within the range 1.25 to 1.7.

7. A system according to claim 1, wherein for catheter lumina with a widest cross-sectional internal dimension of between 2.1 to 2.4 mm, the ratio of the head diameter of the selected brush to the widest cross-sectional internal dimension of the catheter lumen is within the range 1.45 to 1.7.

8. A system according to claim 1, wherein for catheter lumina with a widest cross-sectional internal dimension of between 2.5 to 3.0 mm, the ratio of the head diameter of the selected brush to the widest cross-sectional internal dimension of the catheter lumen is within the range 2.0 to 2.4.

9. A system according to claim 1, wherein for catheter lumina with a widest cross-sectional internal dimension of between 3.2 to 4.0 mm, the ratio of the head diameter of the selected brush to the widest cross-sectional internal dimension of the catheter lumen is within the range 2.0 to 2.5.

10. A system according to claim 1, wherein each of said plurality of brushes has a brush head front end, the bristles of each brush head being configured to compress inwardly and rearwardly as the brush is inserted forwardly into a catheter lumen, the majority of the bristles remaining in a rearwardly orientated direction as the brush is retracted from the catheter lumen.

11. A system according to claim 10, wherein each brush comprises a longitudinally extending wire with the brush head formed at one end of the wire, wherein the brush head comprises laterally extending bristles forming a bristle  
5 head.

12. A system according to claim 11, wherein the wire is of greater length than the catheter lumen.

13. A system according to claim 11, wherein the length of the brush is limited by a user bending the wire at a point  
10 of required length from the terminal end of the bristle head.

14. A system according to claim 1, wherein the bristles are formed of nylon.

15. A system according to claim 11, wherein the gauge of  
15 the wire is greater for short straight catheter lumen compared to the gauge for long, curved catheter lumen.

16. A system according to claim 11, wherein the brush has a shorter wind length for long curved catheter lumen compared to short straight catheter lumen.

20 17. A system according to claim 1, wherein the bristles are arranged in a rear orientated spiral.

18. A system according to claim 1, wherein a sheath is provided for connection to a proximal opening of the catheter.

25 19. A system according to claim 18, wherein the sheath is connected to the catheter lumen by a luer lock connector.

20. A method of removing debris from a catheter lumen, the method comprising;

(a) inserting a brush having bristles into an opening in the catheter lumen,

5 (b) extending the brush to a distal opening of the catheter lumen, and

(c) withdrawing the brush from the catheter lumen; wherein,

whilst extending the brush forward into the catheter lumen, the bristles are urged rearwardly in the opposite direction from the motion of the brush so that they can glide over, and do not dislodge, the debris from the catheter lumen, and

during withdrawal of the brush, a majority of the bristles remain rearwardly orientated in the direction of withdrawal so that the debris is dislodged from the catheter lumen.

21. A method according to claim 20, wherein the dislodged debris is embedded and retained within the bristles.

20 22. A method according to claim 20 or 21, wherein a portion of the brush is extended beyond the distal opening of the catheter.

23. A method according to claim 20, wherein 2.0 mm of the brush is extended beyond the distal opening of the catheter.

24. A method according to claim 22, wherein the bristles which extend beyond the distal opening of the catheter become forwardly orientated during withdrawal of the brush.

25. A method according to claim 24, wherein, during withdrawal of the brush, a reservoir is formed between the

rearwardly orientated bristles and the forwardly orientated bristles, and the reservoir can accumulate dislodged debris which is not embedded within the rearwardly orientated bristles, and the forwardly orientated bristles act to  
5 retain dislodged debris which is not caught by the reservoir.

26. A method according to claim 24, wherein, on withdrawal of the brush from the lumen, the forwardly orientated bristles smooth the surface of the catheter lumen.

10 27. A method according to claim 20, wherein the brush is extended to no closer than 2.0 cm to the distal opening of the catheter.

28. A method according to claim 20, wherein an insertion length of the brush is limited to the required length by a  
15 user bending the wire of the brush at a point of such length from the terminal end of the bristle head, prior to insertion of the brush into the catheter lumen.

29. A method according to claim 20, wherein, once the bristles are full with the debris, the bristle head forms a  
20 plug for removing any additional debris not embedded within the bristles.

30. A method according to claim 20, wherein after withdrawal of the brush, fluid is withdrawn from the lumen to remove any residual loose debris.

25 31. A method according to claim 20, wherein the catheter is *in situ* in a patient.

32. A method according to claim 20, wherein, prior to insertion of the brush into the catheter lumen, the

catheter lumen is treated with a chemical agent to at least partially loosen the debris within the catheter lumen.

33. A method according to claim 32, wherein the catheter lumen is treated with a solution of alcohol prior to  
5 insertion of the brush into the catheter lumen.

34. A brush for use in the system of claim 1.

35. A brush for use in brushing a catheter lumen; the brush having a head of bristles, the bristles having substantially the same length along the brush head's  
10 length;

wherein the ratio of the head diameter of the brush to the widest cross-sectional internal dimension of the catheter lumen is greater than 1.0.

36. A brush according to claim 35, wherein the ratio of  
15 the head diameter of the brush to the widest cross-sectional internal dimension of the catheter lumen is greater than 1.2.

37. A brush according to claim 35, wherein the ratio of the head diameter of the brush to the widest cross-  
20 sectional internal dimension of the catheter lumen is in the range 1.25 to 2.5.

38. A brush according to any one of claim 35, wherein there is a non-linear relationship between the rate of increase of the widest cross-sectional internal dimension  
25 of the catheter lumen and the head diameter of the brush.

39. A brush according to claim 38, wherein the rate of increase of brush head diameter is greater than that of the

widest cross-sectional internal dimension of the catheter lumen.

40. A brush according to claim 35;

wherein if the widest cross-sectional internal  
5 dimension of the catheter lumen is between 0.6 to 2.0 mm,  
the ratio of the head diameter of the brush to the widest  
cross-sectional internal dimension of the catheter lumen is  
within the range 1.25 to 1.7; or

wherein if the widest cross-sectional internal  
10 dimension of the catheter lumen is between 2.1 to 2.4 mm,  
the ratio of the head diameter of the brush to the widest  
cross-sectional internal dimension of the catheter lumen is  
within the range 1.45 to 1.7; or

wherein if the widest cross-sectional internal  
15 dimension of the catheter lumen is between 2.5 to 3.0 mm,  
the ratio of the head diameter of the brush to the widest  
cross-sectional internal dimension of the catheter lumen is  
within the range 2.0 to 2.4; or

wherein if the widest cross-sectional internal  
20 dimension of the catheter lumen is between 3.2 to 4.0 mm,  
the ratio of the head diameter of the brush to the widest  
cross-sectional internal dimension of the catheter lumen is  
within the range 2.0 to 2.5.

41. A brush according to claim 35, wherein the brush head  
25 has a front end and a rear end, wherein during insertion of  
the brush into a catheter lumen in a forward direction, the  
bristles on both the front and rear end orientate  
themselves rearwardly, whilst on withdrawal of the brush  
from the catheter lumen in a rearward direction, the  
30 bristles of the front end orientate themselves in a  
forwardly direction.

42. A set of brushes for use in brushing a catheter lumen the set comprising a plurality of brushes according to claim 35, the set having brushes of different brush head diameter.

5 43. A set of brushes according to claim 42, the set being provided together with a plurality of catheters and indication means for selecting an appropriate brush/catheter combination.

44. A brush according to claim 35, the brush being  
10 provided together with an appropriate catheter.

45. A method for treating an occluded catheter lumen situated in a patient, the method comprising the steps:

(a) inserting a brush having bristles into a proximal opening of the catheter lumen, the catheter lumen  
15 containing debris;

(b) extending the brush towards a distal opening of the catheter lumen, and

(c) withdrawing the brush from the catheter lumen; wherein,

20 whilst extending the brush forward into the catheter lumen, the bristles are urged rearwardly in the opposite direction from the motion of the brush so that they can glide over, and do not dislodge, the debris from the catheter lumen, and

25 during withdrawal of the brush, a majority of the bristles remain rearwardly orientated in the direction of withdrawal so that the debris is dislodged from the catheter lumen.

46. A method according to claim 45, wherein the brush is  
30 extended up to 3 mm beyond the distal opening.



48. A method according to claim 45, wherein the brush is extended no closer than 2.0 cm to the distal opening.

49. A method according to claim 45, wherein before step (a) the catheter is treated with a chemical agent to at least partially loosen the debris.

50. A method according to claim 45, wherein before step (c) the catheter is treated with a chemical agent to at least partially loosen the debris.

51. A method according to claim 45, wherein the patient is placed in a supine position before step (a).

52. A method according to claim 45, wherein after step (c), up to 6 catheter volumes of fluid are withdrawn from the catheter lumen.

53. A method according to claim 52, wherein after step (c), up to 4 to 5 catheter volumes of fluid are withdrawn from the catheter lumen.

54. A method according to claim 52, wherein the catheter volumes of fluid are withdrawn using a syringe of greater than 10cc.